



STB150NF55 STP150NF55 STW150NF55

N-CHANNEL 55V - 0.005 Ω -120A D²PAK/TO-220/TO-247
STripFET™ II POWER MOSFET

AUTOMOTIVE SPECIFIC

| TYPE | V _{DSS} | R _{D(on)} | I _D |
|------------|------------------|--------------------|----------------|
| STB150NF55 | 55 V | <0.006 Ω | 120 A(**) |
| STP150NF55 | 55 V | <0.006 Ω | 120 A(**) |
| STW150NF55 | 55 V | <0.006 Ω | 120 A(**) |

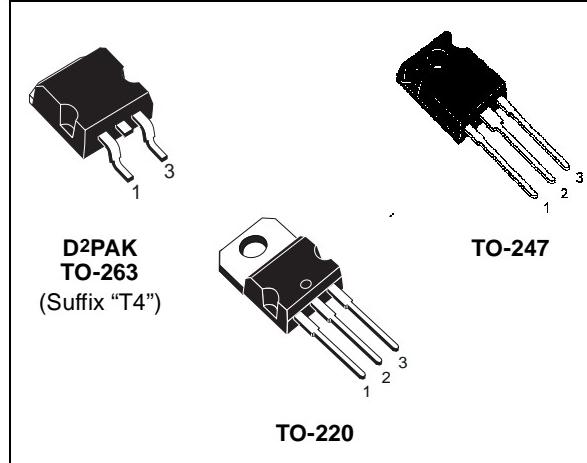
- TYPICAL R_{D(on)} = 0.005 Ω
- SURFACE-MOUNTING D²PAK (TO-263) POWER PACKAGE

DESCRIPTION

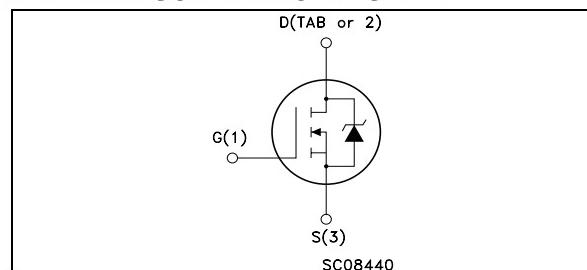
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- SOLENOID AND RELAY DRIVERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- DC-DC & DC-AC CONVERTERS
- AUTOMOTIVE



INTERNAL SCHEMATIC DIAGRAM



Ordering Information

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|--------------|----------|--------------------|-------------|
| STB150NF55T4 | B150NF55 | D ² PAK | TAPE & REEL |
| STP150NF55 | P150NF55 | TO-220 | TUBE |
| STW150NF55 | W150NF55 | TO-247 | TUBE |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---------------------|---|------------|-----------------|
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 55 | V |
| V _{DGR} | Drain-gate Voltage (R _{GS} = 20 k Ω) | 55 | V |
| V _{GS} | Gate-source Voltage | ± 20 | V |
| I _D (**) | Drain Current (continuous) at T _C = 25°C | 120 | A |
| I _D | Drain Current (continuous) at T _C = 100°C | 106 | A |
| I _{DM(•)} | Drain Current (pulsed) | 480 | A |
| P _{tot} | Total Dissipation at T _C = 25°C | 300 | W |
| | Derating Factor | 2.0 | W/ $^{\circ}$ C |
| dv/dt (1) | Peak Diode Recovery voltage slope | 8 | V/ns |
| E _{AS} (2) | Single Pulse Avalanche Energy | 850 | mJ |
| T _{stg} | Storage Temperature | -55 to 175 | °C |
| T _j | Operating Junction Temperature | | |

(•) Pulse width limited by safe operating area.

(**) Current Limited by Package

(1) I_{SD} ≤ 120A, di/dt ≤ 200A/ μ s, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}

(2) Starting T_j = 25 °C, I_D = 60 A, V_{DD} = 30V

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THERMAL DATA

| | | | | |
|---|---|-------------------|--------------------|--------------------|
| R _{thj-case} R _{thj-amb} T _I | Thermal Resistance Junction-case Thermal Resistance Junction-ambient Maximum Lead Temperature For Soldering Purpose | Max Max Typ | 0.5 62.5 300 | °C/W °C/W °C |
|---|---|-------------------|--------------------|--------------------|

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|------|---------|----------|
| V _{(BR)DSS} | Drain-source Breakdown Voltage | I _D = 250 µA V _{GS} = 0 | 55 | | | V |
| I _{DSS} | Zero Gate Voltage Drain Current (V _{GS} = 0) | V _{DS} = Max Rating V _{DS} = Max Rating T _C = 125°C | | | 1 10 | µA µA |
| I _{GSS} | Gate-body Leakage Current (V _{DS} = 0) | V _{GS} = ± 20 V | | | ±100 | nA |

ON (*)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|---|------|-------|-------|------|
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} I _D = 250 µA | 2 | | 4 | V |
| R _{DS(on)} | Static Drain-source On Resistance | V _{GS} = 10 V I _D = 60 A | | 0.005 | 0.006 | Ω |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--|---|---|------|---------------------|------|----------------|
| g _{fs} (*) | Forward Transconductance | V _{DS} = 15 V I _D = 60 A | | 160 | | S |
| C _{iss} C _{oss} C _{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | V _{DS} = 25V, f = 1 MHz, V _{GS} = 0 | | 4400 1050 350 | | pF pF pF |

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|-----------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on Delay Time Rise Time | $V_{DD} = 27.5 \text{ V}$ $I_D = 60 \text{ A}$ $R_G = 4.7 \Omega$ $V_{GS} = 10 \text{ V}$ (Resistive Load, Figure 3) | | 35 180 | | ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD}=27.5 \text{ V}$ $I_D=120\text{A}$ $V_{GS}= 10\text{V}$ | | 140 35 70 | 170 | nC nC nC |

SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|--|------|-----------|------|----------|
| $t_{d(off)}$ t_f | Turn-off Delay Time Fall Time | $V_{DD} = 27.5 \text{ V}$ $I_D = 60 \text{ A}$ $R_G = 4.7\Omega$, $V_{GS} = 10 \text{ V}$ (Resistive Load, Figure 3) | | 140 80 | | ns ns |

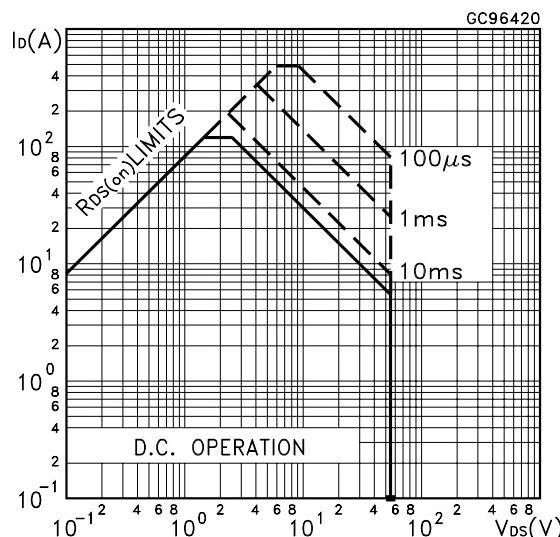
SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|---|------|-------------------|------------|---------------|
| I_{SD} $I_{SDM} (\bullet)$ | Source-drain Current Source-drain Current (pulsed) | | | | 120 480 | A A |
| $V_{SD} (*)$ | Forward On Voltage | $I_{SD} = 120 \text{ A}$ $V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 120 \text{ A}$ $di/dt = 100\text{A}/\mu\text{s}$ $V_{DD} = 25 \text{ V}$ $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5) | | 130 350 7.5 | | ns nC A |

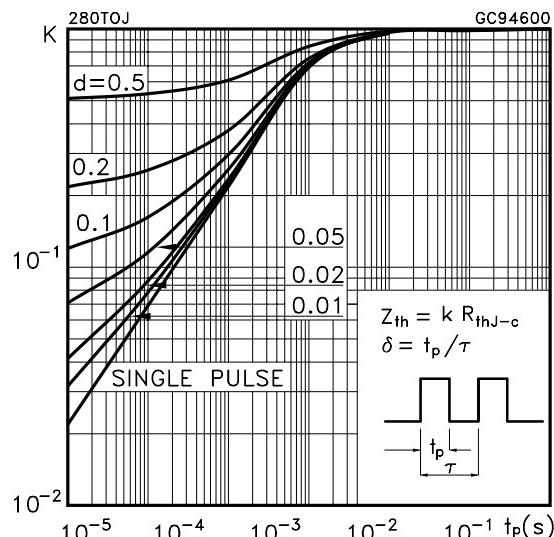
(*)Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

(•)Pulse width limited by safe operating area.

Safe Operating Area

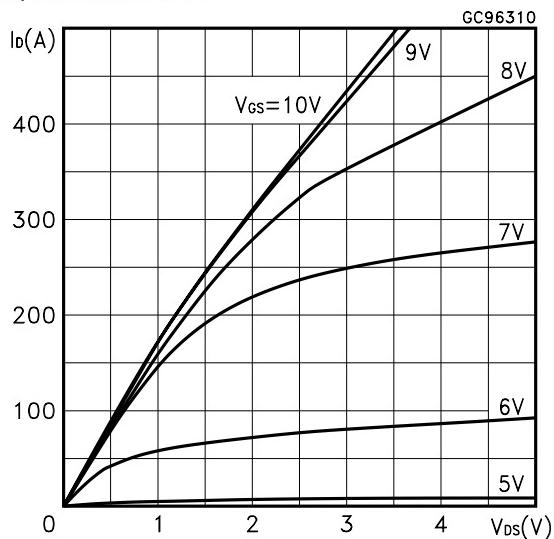


Thermal Impedance

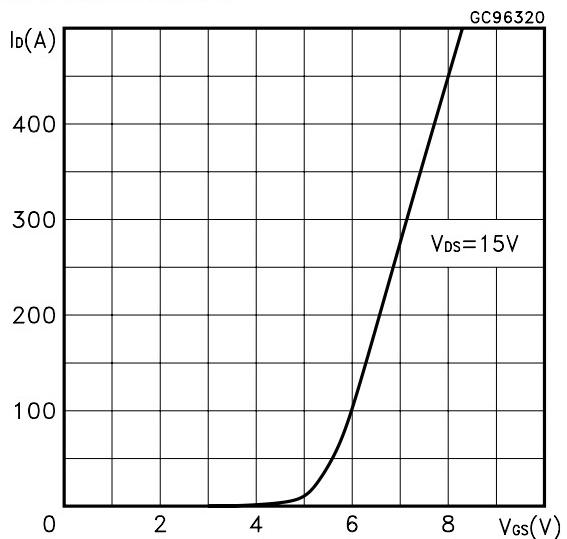


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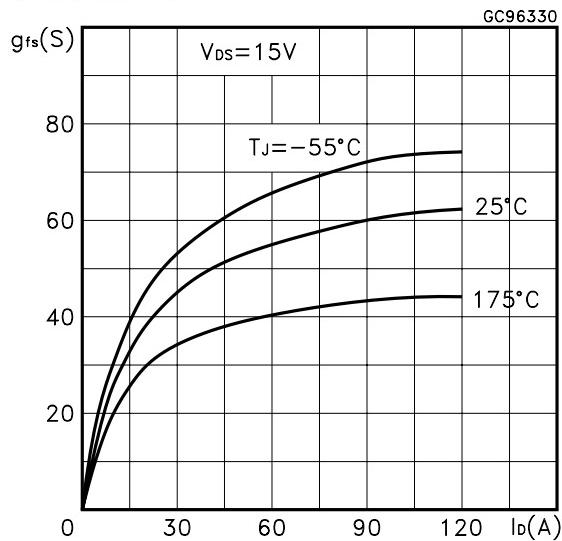
Output Characteristics



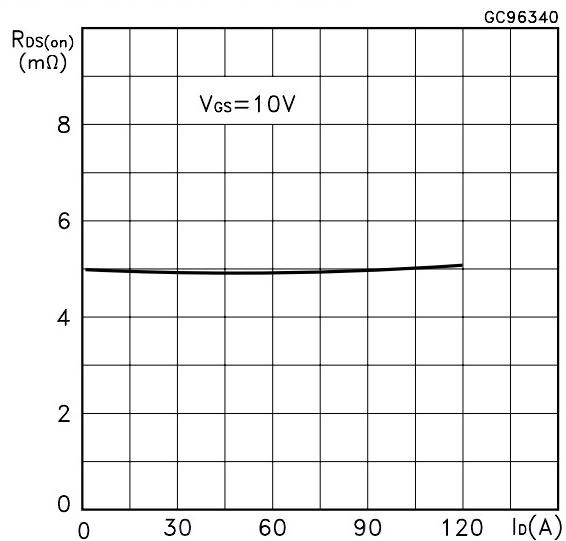
Transfer Characteristics



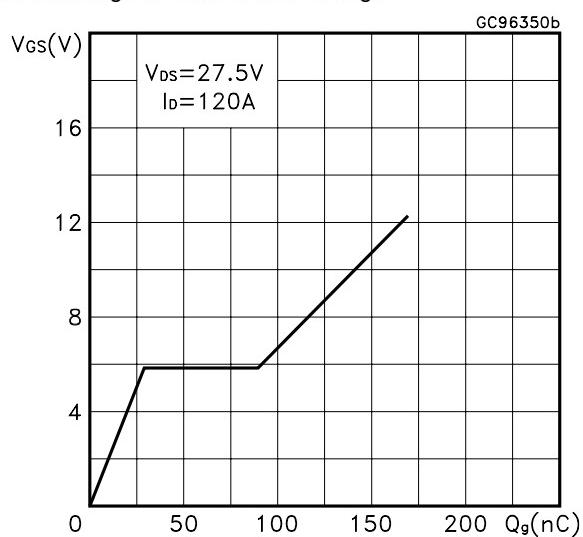
Transconductance



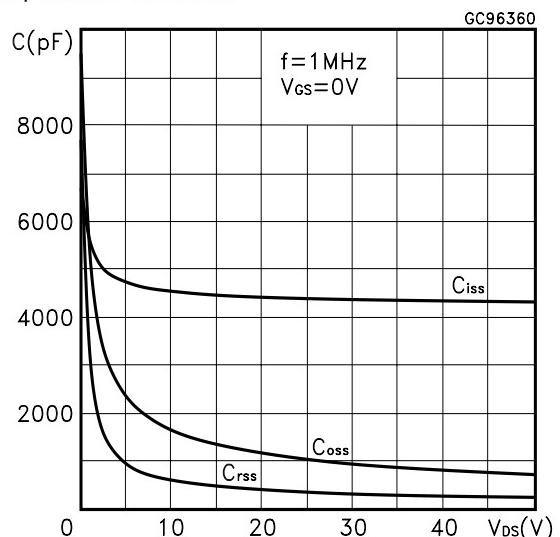
Static Drain-source On Resistance



Gate Charge vs Gate-source Voltage

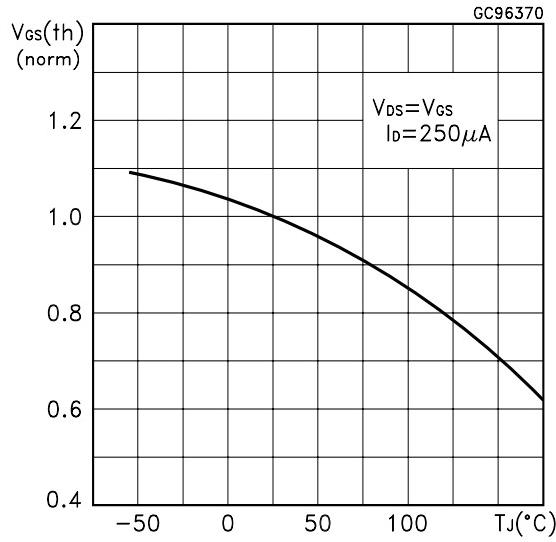


Capacitance Variations

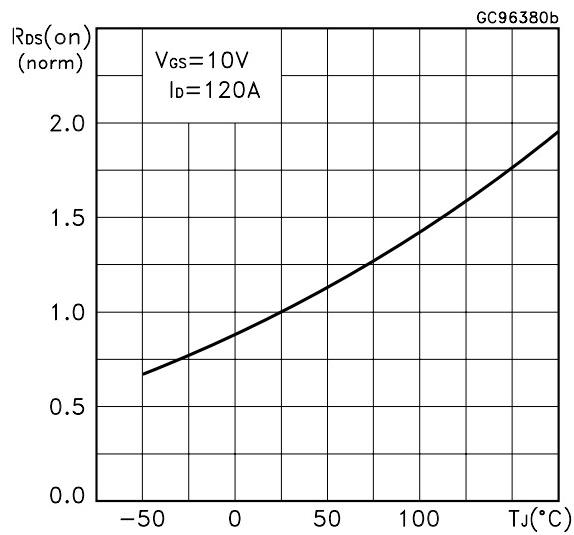


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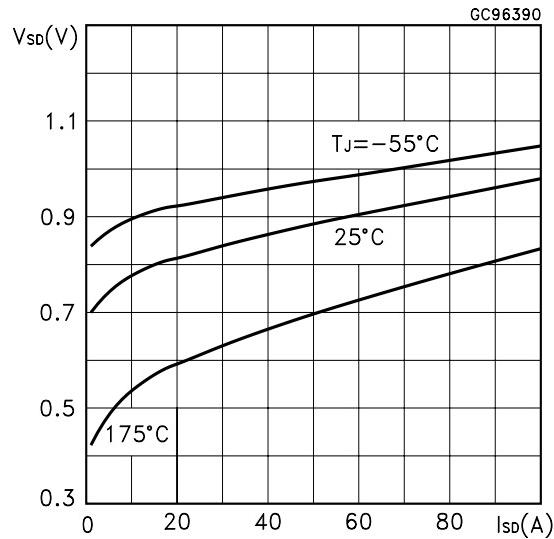
Normalized Gate Threshold Voltage vs Temperature



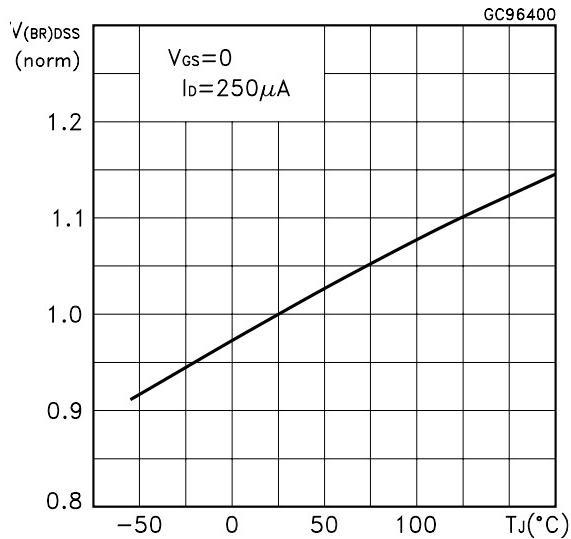
Normalized on Resistance vs Temperature



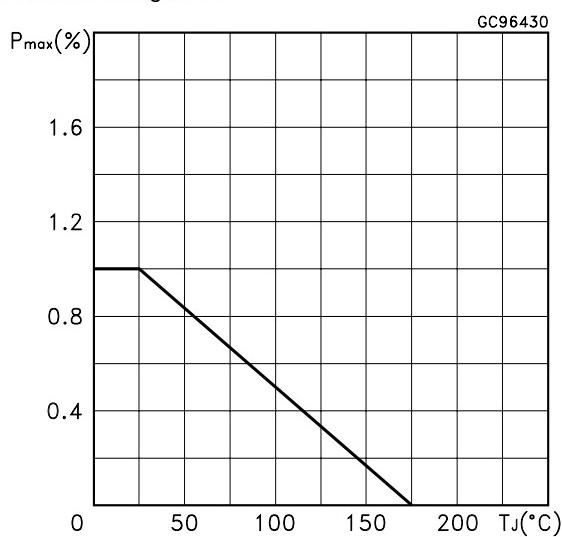
Source-drain Diode Forward Characteristics



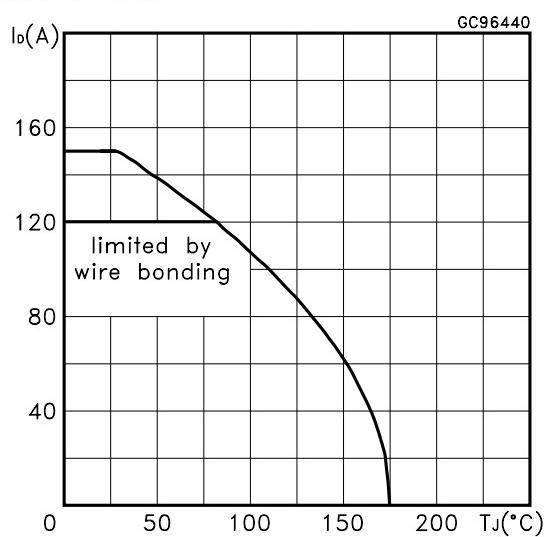
Normalized Breakdown Voltage vs Temperature.



Power Derating vs Tc

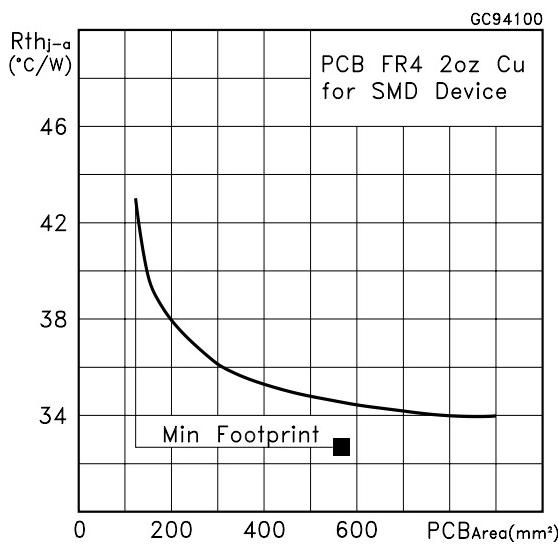


Max Id Current vs Tc.

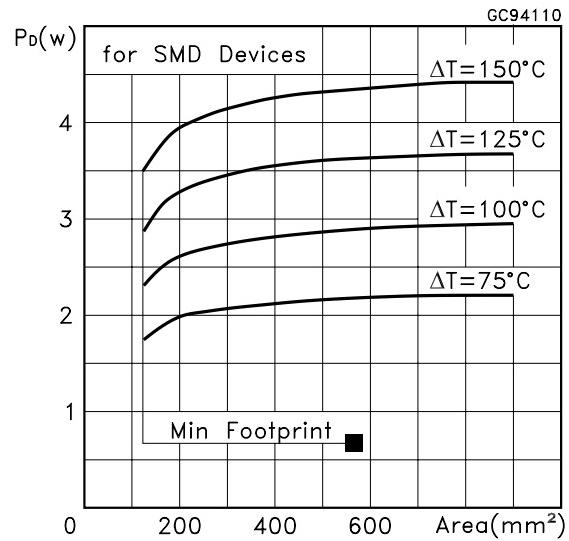


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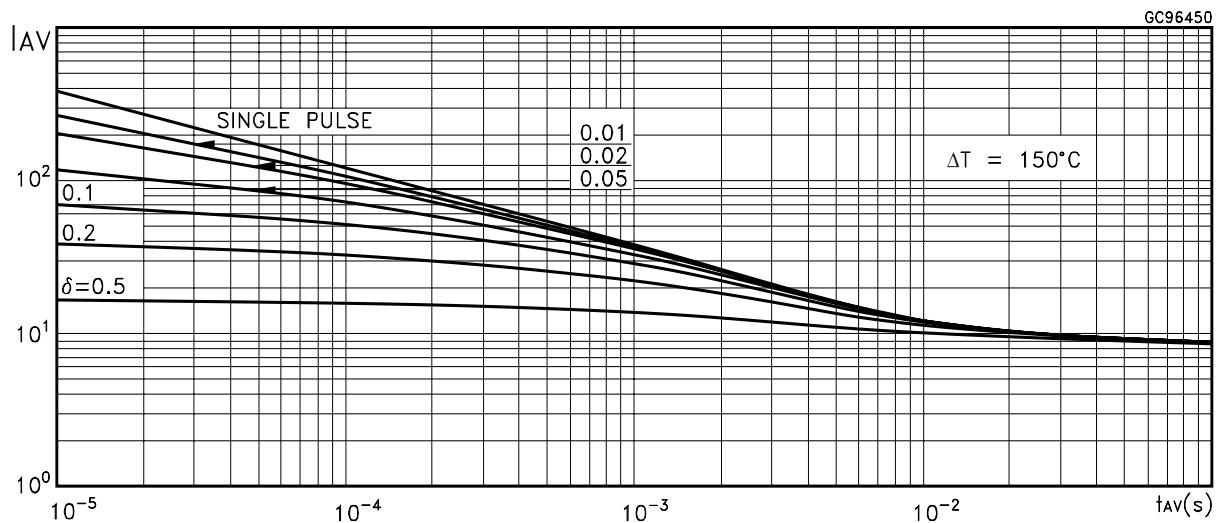
Thermal Resistance R_{thj-a} vs PCB Copper Area



Max Power Dissipation vs PCB Copper Area



Allowable I_{AV} vs. Time in Avalanche



The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * BV_{DSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

I_{AV} is the Allowable Current in Avalanche

P_{D(AVE)} is the Average Power Dissipation in Avalanche (Single Pulse)

t_{AV} is the Time in Avalanche

To derate above 25 °C, at fixed I_{AV}, the following equation must be applied:

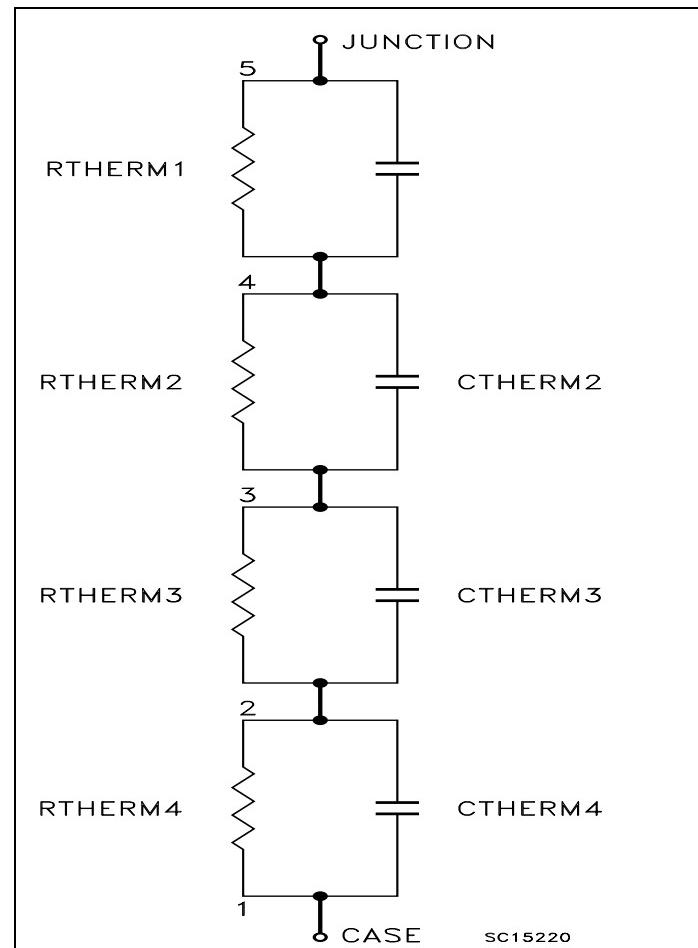
$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * BV_{DSS} * Z_{th})$$

Where:

Z_{th} = K * R_{th} is the value coming from Normalized Thermal Response at fixed pulse width equal to T_{AV}.

SPICE THERMAL MODEL

| Parameter | Node | Value |
|-----------|-------|--------|
| CTHERM1 | 5 - 4 | 0.011 |
| CTHERM2 | 4 - 3 | 0.0012 |
| CTHERM3 | 3 - 2 | 0.05 |
| CTHERM4 | 2 - 1 | 0.1 |
| | | |
| RTERM1 | 5 - 4 | 0.09 |
| RTERM2 | 4 - 3 | 0.02 |
| RTERM3 | 3 - 2 | 0.11 |
| RTERM4 | 2 - 1 | 0.17 |



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Fig. 1: Unclamped Inductive Load Test Circuit

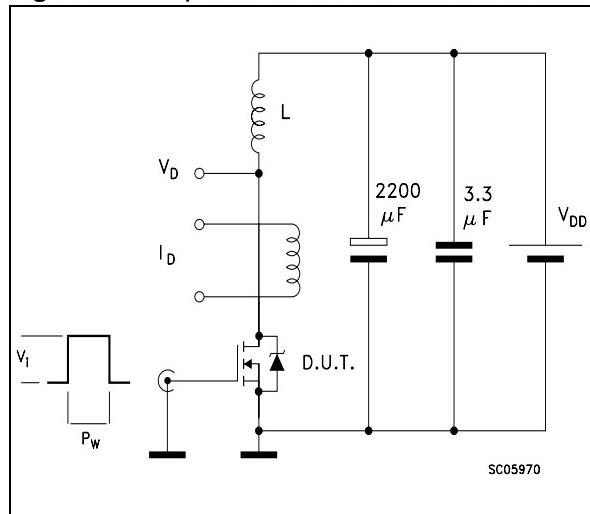


Fig. 2: Unclamped Inductive Waveform

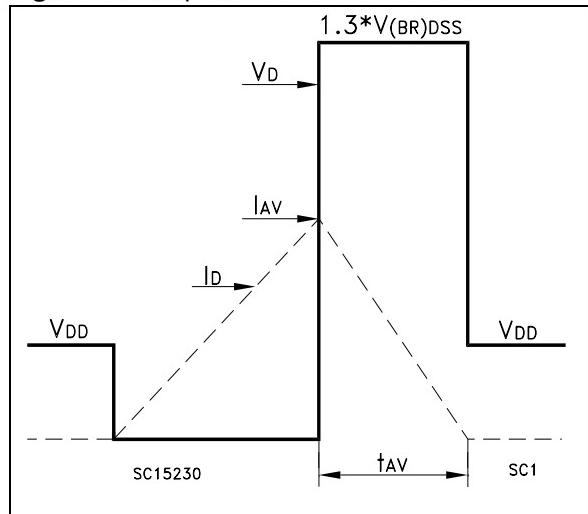


Fig. 3: Switching Times Test Circuits For Resistive Load

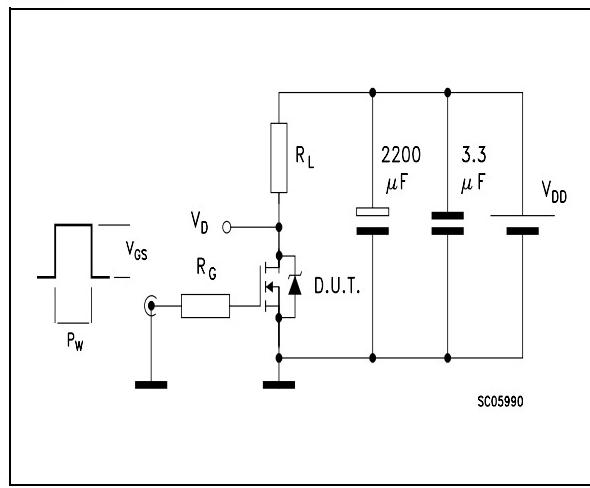


Fig. 3.1: Inductive Load Switching and Diode Recovery Times Waveform

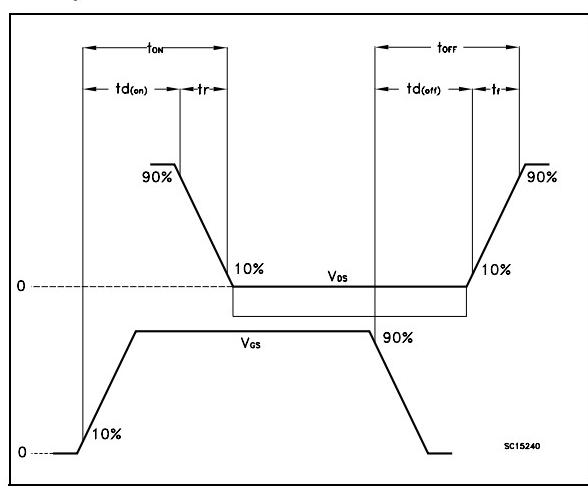


Fig. 4: Gate Charge Test Circuit

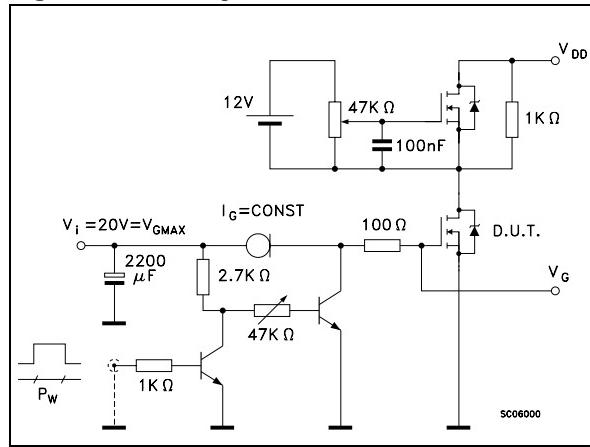


Fig. 4.1: Gate Charge Test Waveform

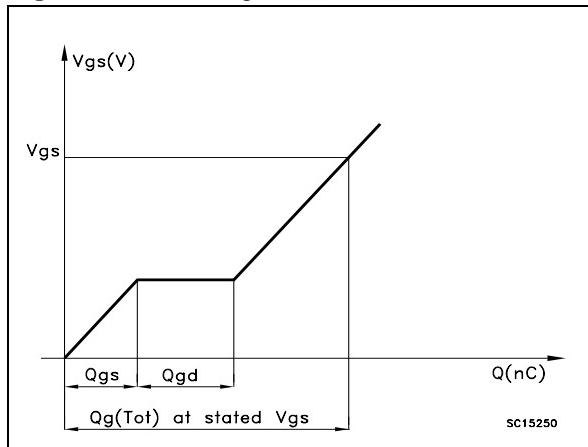


Fig. 5: Unclamped Inductive Load Test Circuit

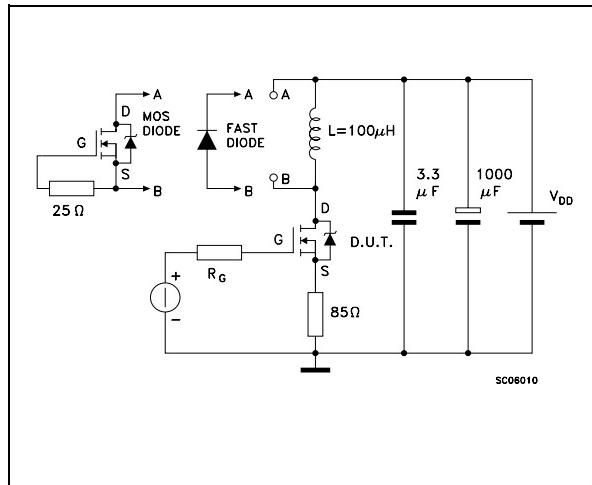
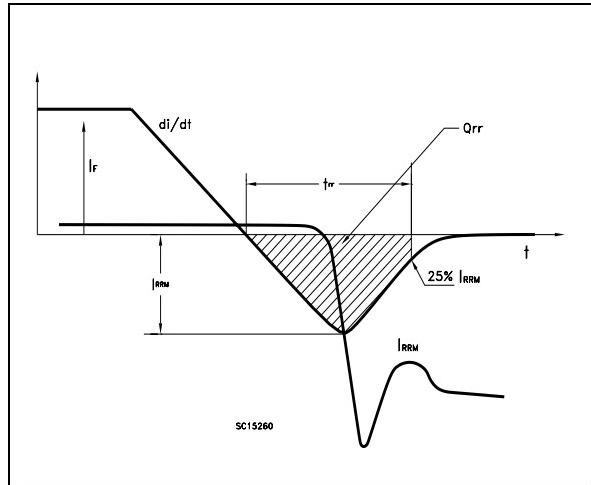


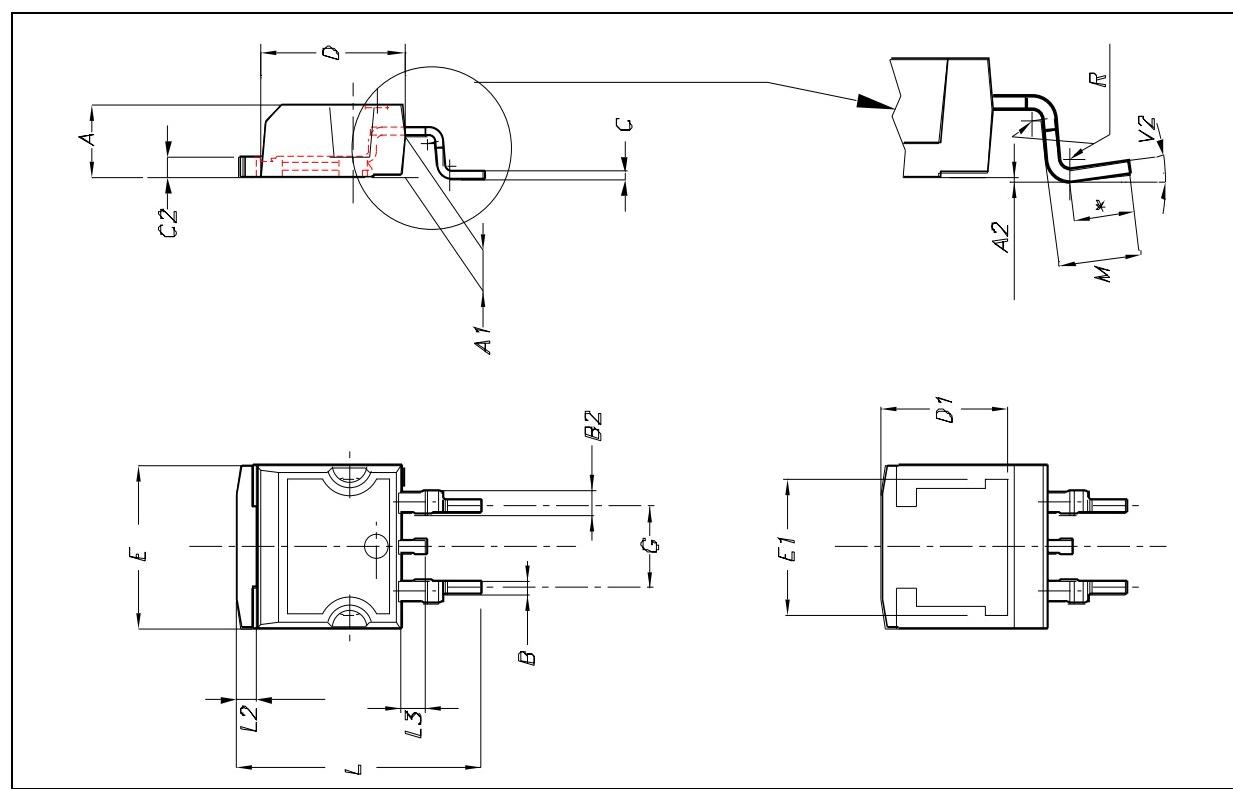
Fig. 5.1: Diode Recovery Times Waveform



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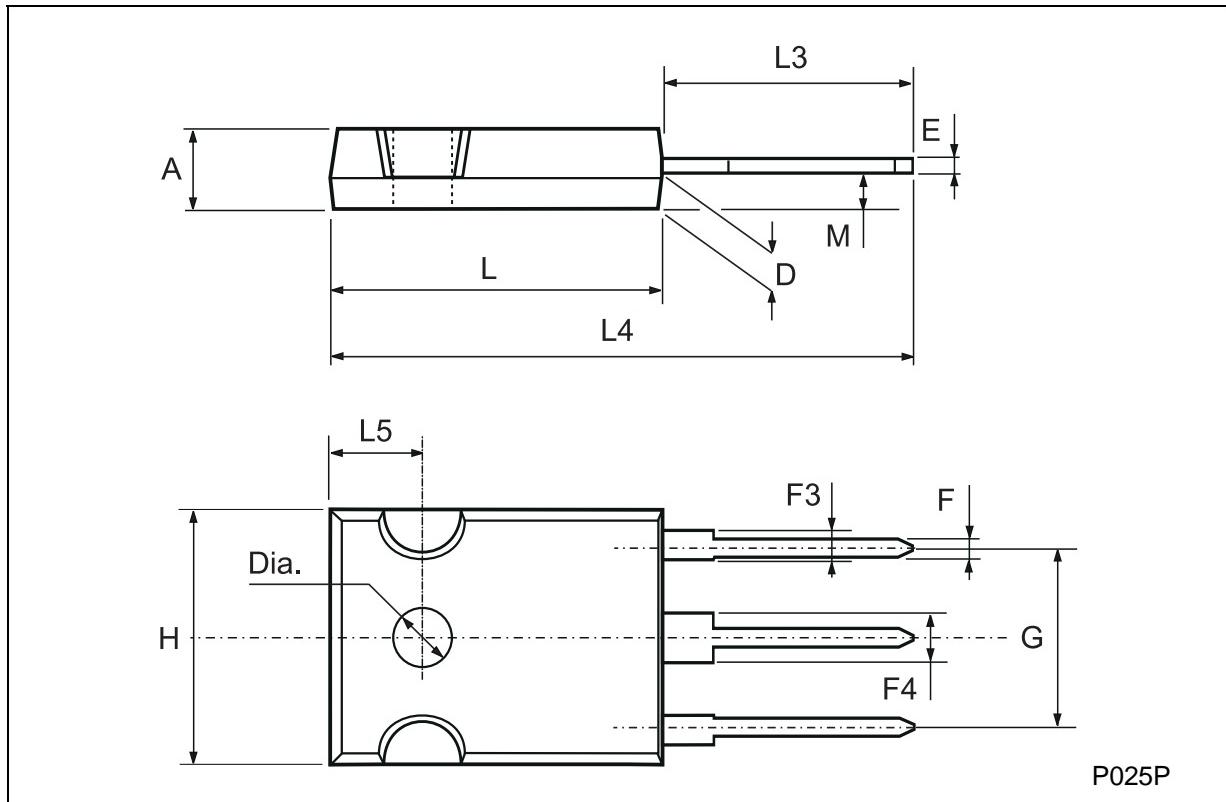
D²PAK MECHANICAL DATA

| DIM. | mm. | | | inch. | | |
|-----------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | TYP. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.028 | | 0.037 |
| B2 | 1.14 | | 1.7 | 0.045 | | 0.067 |
| C | 0.45 | | 0.6 | 0.018 | | 0.024 |
| C2 | 1.21 | | 1.36 | 0.048 | | 0.054 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | | 8 | | | 0.315 | |
| E | 10 | | 10.4 | 0.394 | | 0.409 |
| E1 | | 8.5 | | | 0.334 | |
| G | 4.88 | | 5.28 | 0.192 | | 0.208 |
| L | 15 | | 15.85 | 0.591 | | 0.624 |
| L2 | 1.27 | | 1.4 | 0.050 | | 0.055 |
| L3 | 1.4 | | 1.75 | 0.055 | | 0.069 |
| M | 2.4 | | 3.2 | 0.094 | | 0.126 |
| R | | 0.4 | | | 0.015 | |
| V2 | 0° | | 8° | 0° | | 8° |



TO-247 MECHANICAL DATA

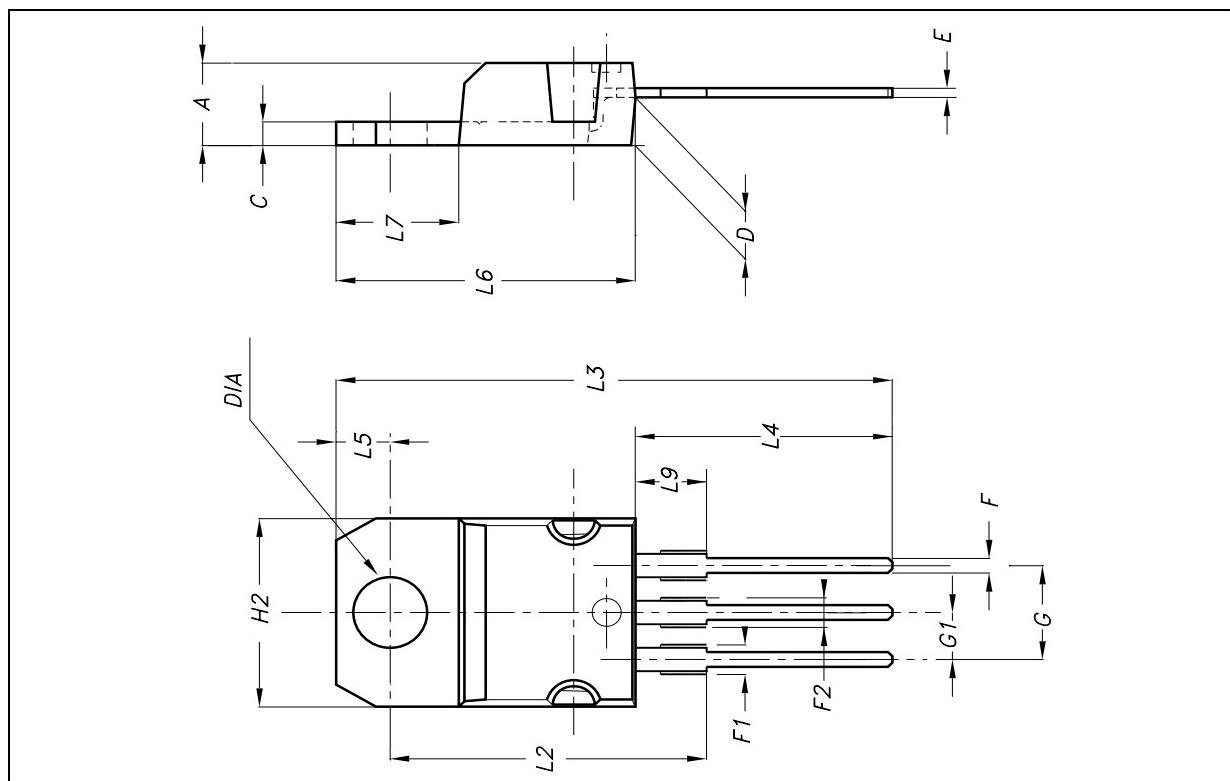
| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.7 | | 5.3 | 0.185 | | 0.209 |
| D | 2.2 | | 2.6 | 0.087 | | 0.102 |
| E | 0.4 | | 0.8 | 0.016 | | 0.031 |
| F | 1 | | 1.4 | 0.039 | | 0.055 |
| F3 | 2 | | 2.4 | 0.079 | | 0.094 |
| F4 | 3 | | 3.4 | 0.118 | | 0.134 |
| G | | 10.9 | | | 0.429 | |
| H | 15.3 | | 15.9 | 0.602 | | 0.626 |
| L | 19.7 | | 20.3 | 0.776 | | 0.779 |
| L3 | 14.2 | | 14.8 | 0.559 | | 0.582 |
| L4 | | 34.6 | | | 1.362 | |
| L5 | | 5.5 | | | 0.217 | |
| M | 2 | | 3 | 0.079 | | 0.118 |



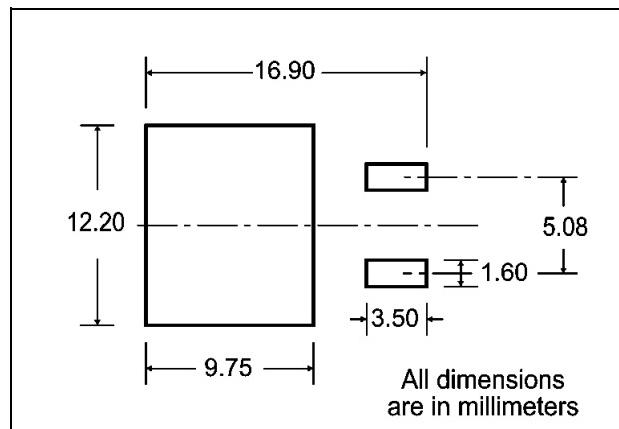
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TO-220 MECHANICAL DATA

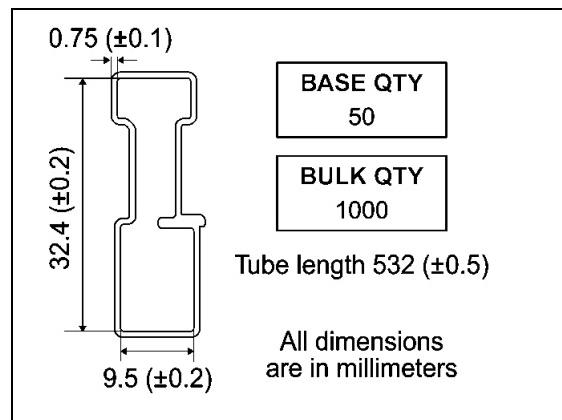
| DIM. | mm. | | | inch. | | |
|------|-------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | TYP. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| C | 1.23 | | 1.32 | 0.048 | | 0.051 |
| D | 2.40 | | 2.72 | 0.094 | | 0.107 |
| E | 0.49 | | 0.70 | 0.019 | | 0.027 |
| F | 0.61 | | 0.88 | 0.024 | | 0.034 |
| F1 | 1.14 | | 1.70 | 0.044 | | 0.067 |
| F2 | 1.14 | | 1.70 | 0.044 | | 0.067 |
| G | 4.95 | | 5.15 | 0.194 | | 0.203 |
| G1 | 2.40 | | 2.70 | 0.094 | | 0.106 |
| H2 | 10 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16.40 | | | 0.645 | |
| L3 | | 28.90 | | | 1.137 | |
| L4 | 13 | | 14 | 0.511 | | 0.551 |
| L5 | 2.65 | | 2.95 | 0.104 | | 0.116 |
| L6 | 15.25 | | 15.75 | 0.600 | | 0.620 |
| L7 | 6.20 | | 6.60 | 0.244 | | 0.260 |
| L9 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| DIA | 3.75 | | 3.85 | 0.147 | | 0.151 |



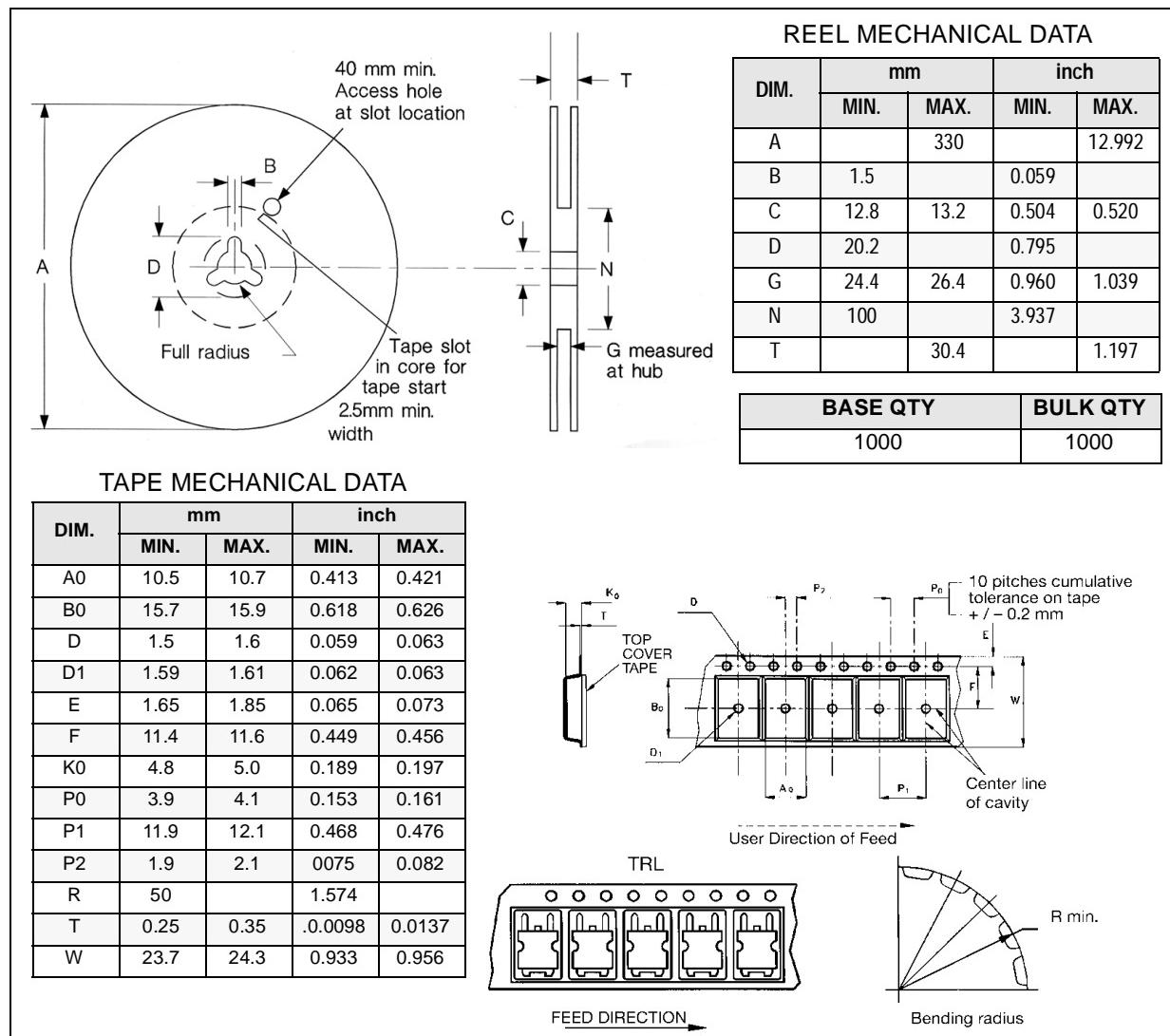
D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*



* on sales type



STB150NF55 STP150NF55 STW150NF55

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